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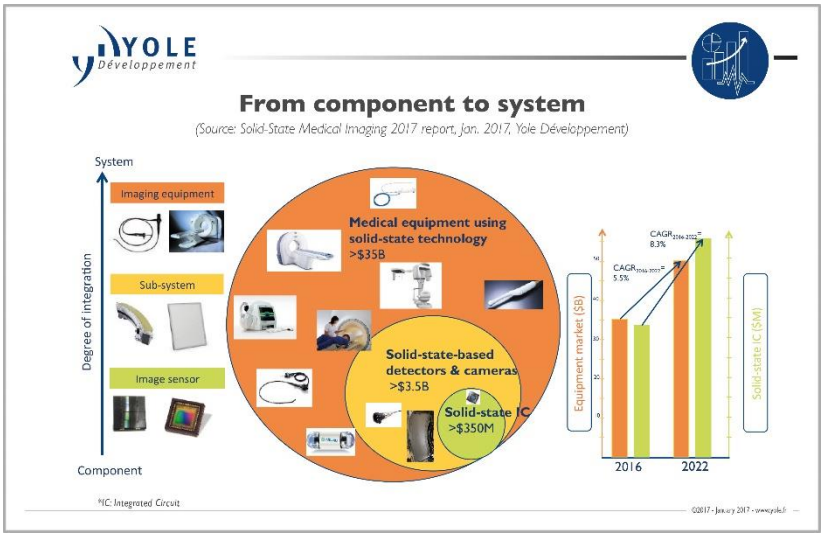
Why are Solid-state IC technologies changing the medical imaging market?

Solid-State Medical Imaging 2017 report – Yole Développement – January 2017

LYON, France – February 14, 2017: According to Yole Développement (Yole), the solid-state IC[1] technologies applied to medical imaging applications including CCD[2], CIS[3], a-Si FPD[4], a-Se FPD[5], SiPM[6] and now cMUT[7] and pMUT[8] are step by step penetrating the medical imaging industry: Yole's analysts announce a US$350 million in 2016 with a comfortable 8.3% CAGR[9] until 2022. In a US$35 billion medical imaging equipment market in 2016 with a 5.5% CAGR[9] until 2022, solid-state IC players are clearly changing the medical imaging landscape by offering competitive disruptive technologies.



The "More than Moore" market research and strategy consulting company, Yole confirms the growing interest of solid-state technologies in medical imaging applications: in this field, companies aim to reach challenges of minimally invasive solutions, safety of patient and early diagnostic, remote diagnostic and cost effectiveness through miniaturization, low power consumption and serial production.

Under this context, Yole releases a new technology & market report entitled Solid-State Medical Imaging. Yole analyzes the medical imaging ecosystem and proposes a relevant overview of solid-state technologies and technological trends. From components to systems, Yole's MedTech team reviews for each types of equipment the major

[1] IC : Integrated Circuit
[2] CCD : Charge Coupled Device
[3] CIS : CMOS Image Sensor
[4] Si-FPD : Silicon Flat Panel Detector
[5] a-Se FPD : Amorphous Selenium Flat Panel Detector
[6] Si-PM : Silicon Photomultiplier
[7] cMUT : Capacitive Micromachined Ultrasound Transducer
[8] pMUT : Piezoelectric Micromachined Ultrasound Transducer
[9] CAGR : Compound Annual Growth Rate

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companies in the supply chains from the sensors to the equipment. Solid-state disruptive solutions bring better performances for existing technologies and pave the way for new market opportunities. Yole's MedTech analysts offer you today a snapshot of the solid-state IC technologies for medical imaging applications.

"For some technologies and applications, wafer volume growth is very significant", explains **Yole's Activity Leader, Pierre Cambou**. *"For example, the development of SiPM[7] in the field of molecular imaging will multiply in quantity by more than 6x over the next five years. This massive transformation from photomultiplier tubes to solid-state IC was derived from the need of multimodal equipment (PET/MRI[10]) but it's going to have a direct consequence in the field of PET/CT[11] and spread all the way to SPECT[12] imaging".* In the case of endoscopy the switch toward solid-state IC technologies started a decade ago and has completely transformed the landscape. The digitization process is almost complete. The new technological trend is now to move from CCD to CMOS image sensors offering higher image quality and miniaturization perspectives. Small-diameter fiberscope is the last endoscopy domain making the transition…

The medical imaging equipment market is led by 4 major players representing more than 75% of the market share. Indeed Siemens Healthineers, GE Healthcare, Philips Healthcare and Canon/Toshiba medical systems are manufacturing the high end imaging equipment including PET/MRI[10], PET/CT[11], SPECT[12] and CT[13] Scanners.
But it is an evolving market and several players are focused on smaller systems and are leader on their market. Olympus, Fujifilm or Sirona are covering imaging markets with endoscopy and dental X-Ray equipment for example.

Medical industry and furthermore medical imaging applications require strong competences and knowledge to meet challenges of performances and patient safety from component to the system. Solid-state sensors are based on semiconductor technologies and processes with huge initial investment. Solid-state technologies impose a new paradigm in the supply chain from highly integrated companies to a horizontal network of specialized suppliers.
Yole's report describes the major players' position in the supply chain and how, among other, TowerJazz or Hamamatsu are working with Teledyne Dalsa, Perkin Elmer, or Zeiss, as well as large system manufacturers, to provide the best imaging solutions. It is worth noting that the medical imaging industry is also still consolidating through tremendous mergers and acquisitions. A total of US$35 billion of

[10] PET/MRI : Positron Emission Tomography/Magnetic Resonance Imaging
[11] PET /CT : Positron Emission Tomography/Computed Tomography
[12] SPECT : Single Photo Emission Computed Tomography
[13] CT : Computed Tomography

strategic acquisition has been made in the 2 last years at various level of the chain showing an exciting activity of the industry. Most of the companies are expanding field of competences through acquisitions:

- Varex acquiring Perkin Elmer x-ray detector field
- Canon and Toshiba Medical Systems to meet Canon growth strategy
- As well as the US$25 billion acquisition of St. Jude Medical by Abbott.

"In our report, forecasts are paired with each modality's technology and application overview, since some key players have made significant moves via solid-state technology", highlights **Dr Benjamin Roussel, Business Unit Manager, MedTech at Yole**.

Rather than replace old markets, new technologies create new ones. Indeed, when trying to understand technology shifts, things may look fuzzy from afar. But by looking very methodically at each segment of the medical imaging equipment industry, and through the filter of solid-state technology, Yole's analysts perceive where the disruption arises. *"The technologies and related use-cases are constantly evolving, providing space for innovators to differentiate themselves",* comments **Jérôme Mouly, Technology & Market Analyst at Yole**. And he adds: *"Numerous new solid-state innovations are ready to enter the market".*

The Solid-State Medical Imaging report delivers lot of insights into the key technologies that are ready to transform the medical imaging industry landscape. To discover detailed information about this analysis (list of companies, table of content and more) go to i-micronews.com, MedTech reports section.

This year, the "More than Moore" market research and strategy consulting company confirms the expansion of its MedTech activities: key trade shows and conferences, a dedicated Yole's Event, a webcast powered by I-Micronews media and more than 6 technology & market analyses… MedTech's team proposes all year long a high added-value overview of the markets evolution and associated disruptive semiconductor technologies for medical. Stay tuned with Yole to understand the technical issues and identify business opportunities. To learn more about our program, contact Clotilde Fabre (fabre@yole.fr).

About Solid-State Medical Imaging 2017 report:

- Authors:

In 1999 **Pierre Cambou** joined the imaging industry. He had earned an Engineering degree from Université de Technologie de Compiègne in parallel to a Master of Science from Virginia Tech in 1998. More recently he graduated from Grenoble Ecole de Management's MBA.

Pierre took several positions at Thomson TCS which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006. In 2012 he founded the start-up Vence Innovation (now called Irlynx) in order to bring to market a disruptive Man to Machine interaction technology. He joined Yole Développement, the "More than Moore" market research and strategy consulting company, as Imaging Activity Leader in 2014.

As a Technology & Market Analyst, **Dr Marjorie Villien** is member of the Microfluidic & Medical Technologies (MedTech) business unit at Yole Développement, the "More than Moore" market research and strategy consulting company. She is a daily contributor to the development of MedTech activities with a dedicated collection of market & technology reports as well as custom consulting projects. After spending two years at Harvard, Marjorie served as a research scientist at INSERM in the field of MRI & PET imaging. She has spoken in numerous international conferences and has authored or coauthored 11 papers and 1 patent. Marjorie Villien is graduated from Grenoble INP and holds a PhD in physics & medical imaging.

Jerôme Mouly serves as a Technology & Market Analyst specialized in microtechnologies for biomedical & medical imaging applications at Yole Développement, the "More than Moore" market research and strategy consulting company. Since 2000, Jérôme has participated in more than 100 marketing and technological analyses for industrial groups, start-ups and institutes related to semiconductor & medical technologies industry. Jérôme holds a Master of Physics from the University of Lyon.

- Companies cited in the report:

Abbott, Acteon, Ajat, Aloka, Analogic, Ambu, AMS, Avinger, Belmont, BioVision Technologies LLC , Bioptigen, Boston Scientific, Caeleste, Canon, CapsoVision Inc., Carestream Health, Circon, Covidien, Corindus, Cmosis (AMS), Crystalvue, Cyber Medical, Dectris, Dexis, Dongbu, Dpix, e2v (Teledyne Dalsa), EndoOptiks, Esaote, Excelitas, ExO system, Fujifilm, Fujifilm Dimatix, Fujifilm Sonosite, General Electric, Genoray, Gendex, GI View, Hansen Medical, Hamamatsu, Heidelberg Engineers, Hitachi, Hologic, Hoya Life Sciences, Huvitz, Imasonic, imXPAD, IntroMedic, Integrated Endoscopy, Intuitive Surgical,Invendo Medical, Italray, Jinshan, Johnson & Johnson, Karl Storz, Ketek, Kolo, Konica Minolta, Kyocera, Medigus, Medtronic, MicroTomography, Micro-Imaging Solutions, Nidek, NinePoint, NovioMEMS, Olympus, OmniVision, ON Semiconductor, Opcom, Optopol, Optovue, Opto, Opko, Owandy, Panasonic, Pentax (Hoya), Perkin Elmer (Varex), Philips, Pixel Plus, Pyxalis, Richard Wolf, Rock West, Samsung, Sayaka, Schick Dental, Schölly, Sectra, SensL, Shimadzu, Siemens, Sirona, SK Hynix, Sony, Sonic Concepts, Stereotaxis, Stephanix, STMicroelectronics, Stryker, St. Jude Medical, Suoer, Swissray, Teledyne DALSA, Terumo, Texas Instruments, Thales, Topcon, Toshiba, TowerJazz, Trixell, Tronics, TSMC, UMC, Varian, Valtronic, Vatech, Vermon, Vims, VivoSeight, Volcano, X-Counter, Xenics, X-FAB, Zeiss, and more…

About Yole Développement – www.yole.fr

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole Développement group has expanded to include more than 50 collaborators worldwide covering MEMS, Compound Semiconductors, LED, Displays, Image Sensors, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The "More than Moore" company Yole, along with its partners System Plus Consulting, Blumorpho and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

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